CLAIMS

1. Process for surface activation and/or devulcanization of sulfur-vulcanized rubber particles, in which to break the sulfur bridges and to reduce the sulfur, the rubber particles are treated in a biotechnological manner in a medium with mesophilic anaerobic and/or mesophilic optionally anaerobic and/or mesophilic microaerophilic bacteria and/or one or more enzyme systems of such bacteria.

2. Process according to claim 1, in which the treatment of the rubber particles is carried out microbially and/or enzymatically, in particular exclusively by the enzyme system, preferably isolated by the bacteria.

3. Process according to anyone of the preceding claims, in which the medium for treating the rubber particles contains water and nutrients and a carbon source and bacteria or consists thereof and/or the concentration of the rubber particle material in the medium is maintained below 35 % by mass.

4. Process according to anyone of the preceding claims, in which to reduce the temperature and/or concentration gradients the medium is intermixed, in particular carefully intermixed, preferably by means of an agitator.

5. Process according to anyone of the preceding claims, in which the treatment is carried out under anaerobic or microaerophilic conditions.

WORKMAN NYDEGGER
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111

6. Process according to anyone of the preceding claims, in which the treatment is carried out at temperatures below 90 °C in particular below 50 DC, preferably within an optimal temperature range for mesophilic bacteria, in particular 33 to 37 Dc.

7. Process according to anyone of the preceding claims, in which the treatment is carried out at a pH value in the region of 5 to 9, in particular from 6 to 8.

8. Process according to anyone of the preceding claims, in which the residence time of the rubber patlicles in the medium is in the region of 4 to 8 days, in particular of 5 to 7 days, preferably approximately 6 days.

9. Process according to anyone of the preceding claims, in which the bacteria are or comprise bacteria capable of sulfur respiration, i.e. sulfur reduction, and in particular belong to one or more of the following bacterial strains: Desulfuromonas thiophila, Desulfuromonas palmitatis, Sulfurospirillum deleyianum, Desulfuromonas acetoxidans.

10. Process according to anyone of the preceding claims, in which the bacteria are or comprise mixed populations.

11. Process according to anyone of the preceding claims, in which the rubber particles to be treated are or comprise rubber powder and/or powdered rubber and/or rubber granulate, the particle size preferably being in the region 01'0.1 to 0.6 mm, in particular from 0.2 to 0.4 mm.

WORKMAN NYDEGGER
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111

12. Process according to anyone of the preceding claims, in which the rubber particles to be treated arc or comprise rubber particles made up of sulfur-vulcanized rubber types or composites based on sulfur-vulcanized rubber types.

13. Process according to anyone of the preceding claims, in which the rubber particles to be treated are or comprise rubber particles made of scrap rubber and/or waste rubber and the process thus serves to reclaim scrap and/or waste rubber.

14. Process according to anyone of the preceding claims, in which the rubber particles to be treated are produced in a comminution process, in particular a peeling process and/or hot grinding and/or cold grinding and/or cryogenic grinding and/or wet grinding, preferably the temperature of the rubber particles remaining so low, in particular lower than 90 °C, that thermooxidative degradation of the rubber particles is substantially avoided.

15. Process according to anyone of the preceding claims, in which the surface activation and/or devulcanization is substantially restricted to the rubber particle surface and/or layers close to the surface, in particular with a thickness of at most 300 urn, in order not to alter the material properties of the main mass of the rubber particle material.

16. Process according to anyone of the preceding claims, in which the treatment of the rubber particles is carried out in a bioreactor.

WORKMAN NYDEGGER
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111

17. Process according to claim 16, in which the addition of the rubber particles to be treated into the bioreactor and/or the removal of the rubber particles to be treated from the bioreactor is carried out continuously or quasi-continuously or discontinuously and/or the bioreactor is operated such that when removing the treated rubber particles from the bioreactor no or only small amounts of bacteria and/or medium containing enzymes for treating the rubber particles are discharged therewith and/or come into contact with atmospheric oxygen, in particular by means of sedimentation of the rubber particle material and its subsequent removal under anaerobic conditions.

18. Process according to anyone of the preceding claims, in which the sulfur bridges contained in the rubber particles are at least partially broken by the treatment and the sulfur is transferred into one or more gas-forming reaction products, hydrogen sulfide being in particular one of the gas-forming reaction products, which preferably is continuously or quasi-continuously removed from the gas phase to avoid inhibition and/or toxification of the bacteria.

19. Process according to anyone of the preceding claims, in which the treated rubber particles are washed with water after treatment, in particular to reduce salt loading, and subsequently are carefully dried, in particular at temperatures below 90 "C.

20. Process according to anyone of the preceding claims, in which rubber particles surface activated by means of the treatment, in particular powdered rubber, are produced which are used to manufacture rubber products, which in particular arc

WORKMAN NYDEGGER
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111

produced only from the treated surface activated rubber particles, or from the surface activated rubber particles and admixed virgin rubber.

21. Process according to anyone of the preceding claims, in which rubber particles surface activated by means of the treatment, in particular powdered rubber, are produced which are used to produce elastomer alloys in particular by phase coupling with plastics, preferably Polypropylene (PP) and/or Polyurethane (PU).

WORKMAN NYDEGGER
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW
1000 EAGLE GATE TOWER
60 EAST SOUTH TEMPLE
SALT LAKE CITY, UTAH 84111